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Non-Solenoidal Tokamak Startup via Inboard Local Helicity Injection on the Pegasus ST[1] J.M. PERRY, J.L. BARR, G.M. BODNER, M.W. BONGARD, R.J. FONCK, J.L. PACHICANO, J.A. REUSCH, C. RODRIGUEZ SANCHEZ, N.J. RICHNER, D.J. SCHLOSSBERG, University of Wisconsin-Madison — Local helicity injection (LHI) is a non-solenoidal startup technique utilizing small injectors at the plasma edge to source current along helical magnetic field lines. Unstable injected current streams relax to a tokamak-like configuration with high toroidal current multiplication. Flexible placement of injectors permits tradeoffs between helicity injection rate, poloidal field induction, and magnetic geometry requirements for initial relaxation. Experiments using a new set of large-area injectors in the lower divertor explore the efficacy of high-field-side (HFS) injection. The increased area (4 cm^2) current source is functional up to full Pegasus toroidal field ($B_{T,inj} = 0.23$ T). However, relaxation to a tokamak state is increasingly frustrated for $B_{T,inj} > 0.15$ T with uniform vacuum vertical field. Paths to relaxation at increased field include: manipulation of vacuum poloidal field geometry; increased injector current; and plasma initiation with outboard injectors, subsequently transitioning to divertor injector drive. During initial tests of HFS injectors, achieved V_{inj} was limited to ~ 600 V by plasma-material interactions on the divertor plate, which may be mitigated by increasing injector elevation. In experiments with helicity injection as the dominant current drive $I_p \sim 0.13$ MA has been attained, with $\overline{T}_e > 100$ eV and $\bar{n}_e \sim 10^{19}$ m^{-3}. Extrapolation to full B_T, longer pulse length, and $V_{inj} \sim 1$ kV suggest $I_p > 0.25$ MA should be attainable in a plasma dominated by helicity drive.

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